

Old Forest Classification Report

Cedar River Municipal Watershed

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Introduction/Background

There are approximately 14,000 acres of forest greater than 190 years old in the Cedar River Municipal Watershed (CRMW). Though this forest is relatively old, it originated from various starting conditions (e.g., different intensities of disturbance and grew under variable environmental conditions (e.g., soil productivity, sun exposure, elevation) resulting in variable forest structural characteristics that may or may not be typical of old-growth forest. The Cedar River Watershed Habitat Conservation Plan (CRW-HCP) identified a need to classify wildlife habitat based on forest structure in forests previously delineated as old growth (CRW-HCP 4.5-33). This classification is based on major structural habitat attributes required by specific threatened and endangered species (e.g., northern spotted owl and marbled murrelet), and generally by other species of concern. This will allow for current assessments of habitat availability for a suite of species and also provide a basis from which forest restoration projects and future conditions can be compared.

Goals

The goals of classifying old forest by major structural attributes in the Cedar River watershed are to:

1. identify potential habitat for the northern spotted owl (*Strix occidentalis caurina*);
2. identify potential habitat for the marbled murrelets (*Brachyramphus marmoratus*);
3. have the capability to identify potential habitat for other species of concern; and,
4. quantify reference conditions for forest restoration targets.

Methods

Old forest characteristics were measured in 2003 at 19 permanent sample plots (PSPs) placed on a stratified-random watershed-wide grid. This sampling effort provided for a coarse quantification of forest characteristics but did not have enough resolution for a geographically referenced assessment of habitat. Consequently, in 2005 18 additional PSPs were sampled in old forest that were prestratified by four environmental variables (site class, aspect, elevation, forest age) and the representation of the 2003 PSPs within the resulting polygons. New plots were located in areas where significant numbers of acres in each of the four environmental strata were not yet sampled or representatively sampled. Elevation was used as a surrogate for forest zone, with the western hemlock zone generally occurring below 2,800' and the Pacific silver fir zone above. Fifty polygon classes were delineated using all possible combinations of the environmental variables (site class, aspect, and elevation) where the forest age was greater than 190 years (Table 1). Forest structure data from the PSPs were used to classify the derived polygons, including delineation of potential northern spotted owl and marbled murrelet habitat.

Old Forest Classification Report

Results

Table 1 provides summary of select data by environmental variable. Table 2 includes some the major forest characteristic data of each of the 37 old forest PSPs. These tables provide the information needed to locate habitat appropriate for other species of concern as well as reference conditions for forest restoration targets (project goals 3 and 4). Habitat delineations for northern spotted owl and marbled murrelet (project goals 1 and 2) are dealt with separately.

Old Forest Classification Report

Table 1. Summary of old forest PSP data in the CRMW.

Elevation	Aspect	Site Class	CRMW Acres	# Plots	TPA			DBH (")			Maximum Age			Dominant Species
					Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	
<2800'	Flat	unknown	0	0										
		II	43	0										
		III	0	0										
		IV	0	0										
		V	0	0										
	North	unknown	68	0										
		II	0	0										
		III	418	2	145	158	170	18.2	21.0	23.7		299		WH/DF/RC
		IV	93	1		85			22.0				DF/NF/WH	
		V	0	0										
	East	unknown	24	0										
		II	7	0										
		III	293	1		130			17.6			256		WH
		IV	87	1		215			18.6					WH/DF/RC
		V	0	0										
	South	unknown	15	0										
		II	36	0										
		III	322	1		170			16.6			115		DF/WH
		IV	38	0										
		V	0	0										
	West	unknown	11	0										
		II	35	0										
		III	246	1		60			27.6			293		WH/DF/RC
		IV	65	0										
		V	0	0										
>2800'	Flat	unknown	0	0										
		II	0	0										
		III	0	0										
		IV	0	0										
		V	0	0										
	North	unknown	744	2	138	159	180	15.0	16.1	17.1				SF/MH/WH
		II	0	0										
		III	50	1		175			24.4					WH/DF
		IV	739	2	83	144	205	11.4	19.8	28.2	169	201	232	WH/RC
		V	1,702	4	120	156	190	17.2	19.9	22.2	233	251	280	SF/MH/WH
	East	unknown	613	2	78	124	170	15.9	16.9	17.8				WH/SF/RC
		II	0	0										
		III	8	0										
		IV	601	2	83	84	85	23.1	23.2	23.2	270	271	271	WH/DF
		V	1,533	3	58	153	250	14.9	17.6	23.0		223		SF/WH
	South	unknown	330	0										
		II	0	0										
		III	24	0										
		IV	738	2	145	168	190	15.9	17.3	18.7		234		WH/DF
		V	1,625	2	195	203	210	12.9	13.9	14.9	243	253	263	SF/DF
	West	unknown	698	3	125	135	140	19.1	19.7	20.1	308	504	699	WH/SF/RC
		II	0	0										
		III	29	1		170			20.1					SF/MH
		IV	791	3	115	224	290	13.4	18.6	25.9		94		WH/DF/SF
		V	2,184	3	88	213	300	11.4	17.1	25.7		227		SF/WH
Total			14,210	37	58	158	300	11.4	19.0	28.2	169	261	699	

DF = Douglas fir, MH = mountain hemlock, NF = noble fir, RC = western redcedar, SF = Pacific silver fir, WH = western hemlock

Table 2. Old Forest PSP Data Summary

Plot #	Sample Year	Basin	Site Index*		Site Class	Aspect			Elev ('asl)	Slope (°)	TPA				Trees				Snags/acre >20"	Marine Dist (miles)	Large Limbs	Percent Basal Area**						STOC Habitat ☺	MAMU Habitat ☹	Class▯
			Spp	Ht		Deg	Dir (4)	Dir (8)			>5"	>10"	>20"	>30"	BA	dbh	Qdbh	Max Ht				SF	NF	DF	RC	WH	MH			
2110102128	2003	N Fork Cedar	DF	111	3	326	N	NW	2,542	42	145	140	100	35	492	23.7	12.5	151	10	38	?	3		23	29	44		I	M	1130
2110121126	2005	N Fork Cedar	DF	112	3	315	N	NW	2,727	12	170	165	85	10	345	18.2	9.6	137	5	40	L			37	6	57		I	M	1130
2208141124	2005	Chester Morse	WH	77	4	315	N	NW	2,617	28	85	75	25	18	387	22.0	14.4	227	3	28	?	4	21	50	7	18		N	M	1140
2208134128	2003	Chester Morse	DF	105	3	101	E	E	2,290	30	130	120	50	5	245	17.6	9.3	116	10	29	?			3	1	95		II	L	1230
2110044092	2005	Upper Cedar	WH	77	4	45	E	NE	2,643	29	215	195	115	10	461	18.6	9.9	132	5	37	?			17	17	65		I	M	1240
2209164128	2003	Chester Morse	DF	111	3	200	S	S	2,706	32	170	125	30	30	413	16.6	10.5	176	0	32	M			78	1	21		N	M	1330
2209361128	2003	Upper Cedar	DF	111	3	245	W	SW	2,252	5	60	60	55	23	261	27.6	14.1	154	13	34	?			34	13	53		N	M	1430
2209143098	2005	McClellen	NA	NA	0	315	N	NW	4,376	18	180	168	28	0	238	15.0	7.8	90	3	33	L	44					56	II	L	2100
2109142222	2005	Rex	NA	NA	0	315	N	NW	2,940	20	138	80	38	28	358	17.1	10.9	164	18	33	M	39			19	42		II	L	2101
2110141094	2005	N Fork Cedar	DF	112	3	360	N	N	3,326	28	175	175	135	45	598	24.4	12.5	162	5	39	L			35	5	60		I	M	2130
2110061128	2003	Upper Cedar	WH	80	4	20	N	N	3,101	32	83	83	70	40	381	28.2	14.5	164	15	36	?					100		I	M	2140
2208264128	2003	M Fork Taylor	WH	80	4	29	N	NE	3,011	16	205	60	25	5	268	11.4	7.7	167	0	28	?	10			47	43		N	L	2140
2110213128	2003	Goat	WH	67	5	330	N	NW	4,469	30	135	135	90	5	329	20.7	10.6	123	0	37	?	64		12		24		III	L	2150
2111183128	2003	N Fork Cedar	WH	67	5	360	N	N	4,465	29	190	170	80	30	479	19.5	10.8	153	5	41	?	61					39	I	L	2150
2210344128	2003	Bear	WH	65	5	346	N	N	3,856	29	120	110	80	20	360	22.2	11.7	135	5	39	?	77				2	21	I	L	2150
2109224032	2005	Rex	WH	67	5	315	N	NW	3,874	2	180	135	50	40	421	17.2	10.4	133	0	33	L	21					79	III	M	2151
2110224026	2005	S Fork Cedar	NA	NA	0	45	E	NE	2,918	1	78	55	25	15	181	17.8	10.3	150	3	39	?	36			16	48		N	L	2200
2109154010	2005	Rex	NA	NA	0	45	E	NE	3,008	2	170	80	40	30	437	15.9	10.9	160	10	33	M	14			16	65	4	II	M	2201
2110083128	2003	Seattle	WH	77	4	133	E	SE	3,130	23	83	48	45	40	358	23.2	14.1	169	8	36	?	2		45	7	45		I	M	2240
2110163128	2003	Goat	WH	77	4	132	E	SE	3,216	20	85	75	53	25	297	23.1	12.7	152	5	37	M	28	4	25	6	37		N	M	2240
2110134034	2005	N Fork Cedar	WH	67	5	45	E	NE	4,320	28	250	220	55	5	343	15.0	7.9	119	0	40	M	80					20	III	L	2250
2210363128	2003	N Fork Cedar	WH	65	5	95	E	E	3,916	19	58	53	35	18	189	23.0	12.3	149	5	40	?	57		17		25		N	L	2250
2109162102	2005	Lindsay	WH	67	5	45	E	NE	3,590	15	150	105	45	10	256	14.9	8.8	137	15	31	M	63				37		II	L	2251
2208261128	2003	M Fork Taylor	WH	77	4	190	S	S	3,544	17	145	60	53	35	337	15.9	10.3	171	50	28	?	8		21	2	69		I	M	2340
2209243060	2005	Upper Cedar	WH	77	4	180	S	S	3,430	32	190	155	85	25	422	18.7	10.1	134	0	34	L	0		31	11	58		III	M	2340
2111064128	2003	N Fork Cedar	WH	67	5	160	S	S	3,636	25	195	120	70	15	306	14.9	8.5	148	15	41	L	22		67		11		II	M	2350
2210341128	2003	Bear	WH	65	5	218	S	SW	3,679	31	210	140	45	5	230	12.9	7.1	138	5	39	?	67	6	22		5		II	L	2350
2110164128	2003	Goat	NA	NA	0	306	W	NW	3,501	12	125	120	65	20	322	20.1	10.9	153	15	38	?	35				59	6	II	L	2400
2111053224	2005	N Fork Cedar	NA	NA	0	225	W	SW	3,859	7	140	115	80	30	368	19.9	11.0	142	0	42	?	61		10		21	8	N	L	2400
2109142128	2003	Rex	NA	NA	0	244	W	SW	2,976	22	140	80	55	43	440	19.1	12.0	166	5	33	H	16		5	44	36	0	I	H	2401
2110034038	2005	Bear	DF	111	3	225	W	SW	3,901	20	170	165	100	10	399	20.1	10.4	113	10	39	L	69					31	I	L	2430
2110062252	2005	Findley	WH	77	4	270	W	W	3,182	15	115	115	95	35	454	25.9	13.4	170	20	35	M	3	7	22		68		I	M	2440
2110121230	2005	N Fork Cedar	WH	77	4	270	W	W	3,338	28	290	220	105	30	556	16.6	9.4	147	0	41	?	15	8	68		9		III	M	2440
2208161128	2003	Lower Cedar	WH	88	4	310	W	NW	3,000	27	240	130	30	30	348	13.4	8.2	150	0	26	L	12				88		III	M	2440
2109054192	2005	Boulder	WH	67	5	270	W	W	3,826	20	88	85	75	18	368	25.7	13.9	183	15	30	H	25				75		I	H	2450
2110073028	2005	Pine	WH	67	5	225	W	SW	4,278	18	300	150	50	5	284	11.4	6.6	121	15	35	L	83				17		II	L	2450
2110073128	2003	Pine	WH	67	5	247	W	SW	4,199	12	250	170	60	10	345	14.2	8.0	131	0	35	?	93					7	III	L	2450
*100-yr curve for DF, 50-yr curve for WH									Ave	3,396	21	158	120	63	21	359	19.0	10.6	148	8										
**from FVS output, dominant species in bold									min	2,252	1	58	48	25	0	181	11.4	6.6	90	0										
J:\ResMan\WS541\Public\Forest Ecology unit\Old-Growth Characterization\Data\Size Classes.xls									max	4,469	42	300	220	135	45	598	28.2	14.5	227	50										

☺ I = nesting = >75 tpa >20" dbh or >35 tpa >30" dbh, >3 snags/acre >20" dbh
II = foraging = 115-280 tpa >5" dbh and >85" tall, >2 snags/acre >20" dbh
III = dispersal = 130-300 tpa >10" dbh

● H = 10+ large limbs/acre, >10 tpa >30" dbh, SF <33% BA, distance to marine <37 miles
M = >5 large limbs/acre, SF <33% BA OR >10 tpa >30" dbh, SF <33% BA
L = SF >33% BA OR 0-5 large limbs/acre OR >10 tpa >30" dbh
? = not enough data

▣Classes:							
Elevation		Aspect		Site Class		Age	
1000	<2800'	100	North	10	I	0	Other Rex
2000	>2800'	200	East	20	II	1	
		300	South	30	III		
		400	West	40	IV		
				50	V		
				0	NA		

Old Forest Classification Report

Northern Spotted Owl Habitat

Northern spotted owl habitat is divided into types based on use; nesting, roosting, foraging, and dispersal (Table 3). Since these habitat definitions are too complex for the available data they were simplified to allow for landscape-scale classification (Table 4).

Table 3. Northern spotted owl habitat (Washington Department of Natural Resources' forest practice rules – WAC 222-16-085).

Characteristic	Habitat Type		
	I	II	III
Use	Nesting Roosting Foraging Dispersal	Roosting Foraging Dispersal	Dispersal
Stand Size (acres)	NA	NA	5
Tree Species	NA	≥30% conifer	≥70% conifer, ≥6" dbh
Trees Size/Density	>75 tpa >20" dbh OR >35 tpa >30" dbh	115-280 tpa, ≥4" dbh, and >85' tall	130-300 tpa, ≥10" dbh
Canopy Closure (%)	≥60	≥70	≥70
Snags	>3 tpa, ≥20" dbh, ≥16' tall	>2 tpa, ≥20" dbh, ≥16' tall	NA
Downed Wood	>2 logs/acre, ≥20" dbh	≥10% of ground covered in >4" wood	NA
Canopy Layers	Multi	≥2, 25-50% intermediate trees	>20' between shrub and lower tree canopy

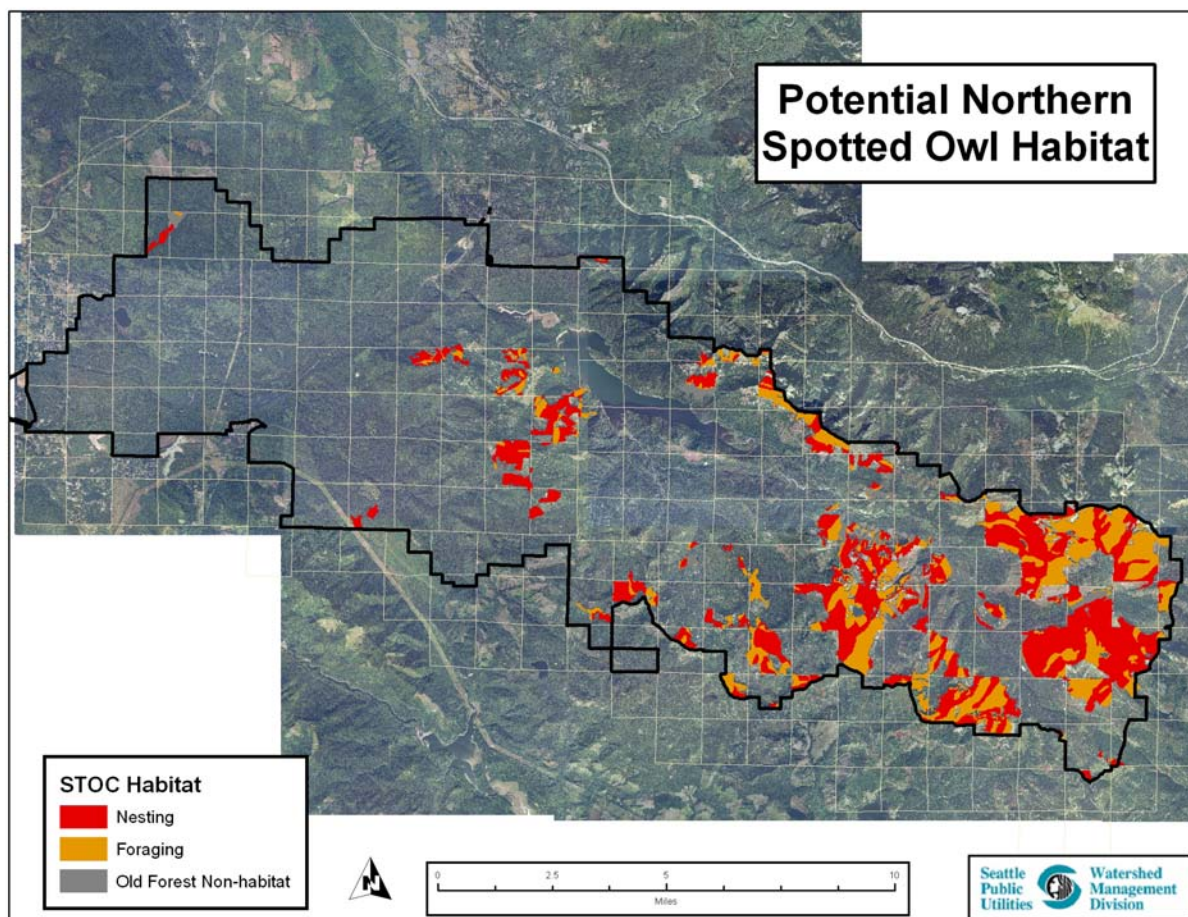
Table 4. Simplified northern spotted owl habitat.

Characteristic	Habitat Type		
	Nesting	Foraging	Dispersal
Trees Size/Density	>75 tpa >20" dbh OR >35 tpa >30" dbh	115-280 tpa, ≥4" dbh, and >85' tall	130-300 tpa, ≥10" dbh
Snags	≥3 tpa, ≥20" dbh	≥2 tpa, ≥20" dbh	NA

Applying this definition of spotted owl habitat to the PSP data resulted in each plot being classified as nesting, foraging, or dispersal habitat (Table 2). Since 37 PSPs did not allow for a statistically relevant classification of environmental polygons, the polygons were classified by the best PSP habitat found in each polygon. This prudent approach was taken to identify the best available habitat in an attempt to focus future survey efforts. Patch size was not included in this classification but is certainly a consideration in home range suitability. It can be used as a post-classification mask if further analysis of this data is pursued. The amount of potential habitat is listed and shown in Figure 1 and Table 5, respectively.

Old Forest Classification Report

Figure 1. Potential northern spotted owl habitat in old forest in the Cedar River Municipal Watershed.



(Source: J:\SSW\WS541\Secure\Fish and Wildlife\SPOW\Maps\STOC_habitat.jpg)

Table 5. Potential northern spotted owl habitat in the Cedar River Municipal Watershed.

Habitat Type	Acres
Nesting	8,136
Foraging	5,349
Dispersal	0
Non-Habitat	660
Total	14,146

2. *Marbled Murrelet Habitat*

Marbled murrelet nesting habitat can generally be defined as forest structure that provides large branches in the upper tree canopy, canopy protection for the nest, and canopy openness to allow flight access to and from the nest (murrelets are awkward flyers). More specifically murrelet habitat can be defined as (updated from Hamer and Nelson 1995):

- nesting platforms on branches with >8" diameter at trunk (>4" diameter branch at nest) and >33' off the ground (usually >75');
- Douglas-fir, western hemlock, Sitka spruce, or western redcedar trees >35" dbh and >100' tall;
- patch size >7 acres;
- usually on slopes <45%;
- elevations <5,000' asl (usually <3,400'); and,
- within 52 miles of marine waters (usually <37 miles).

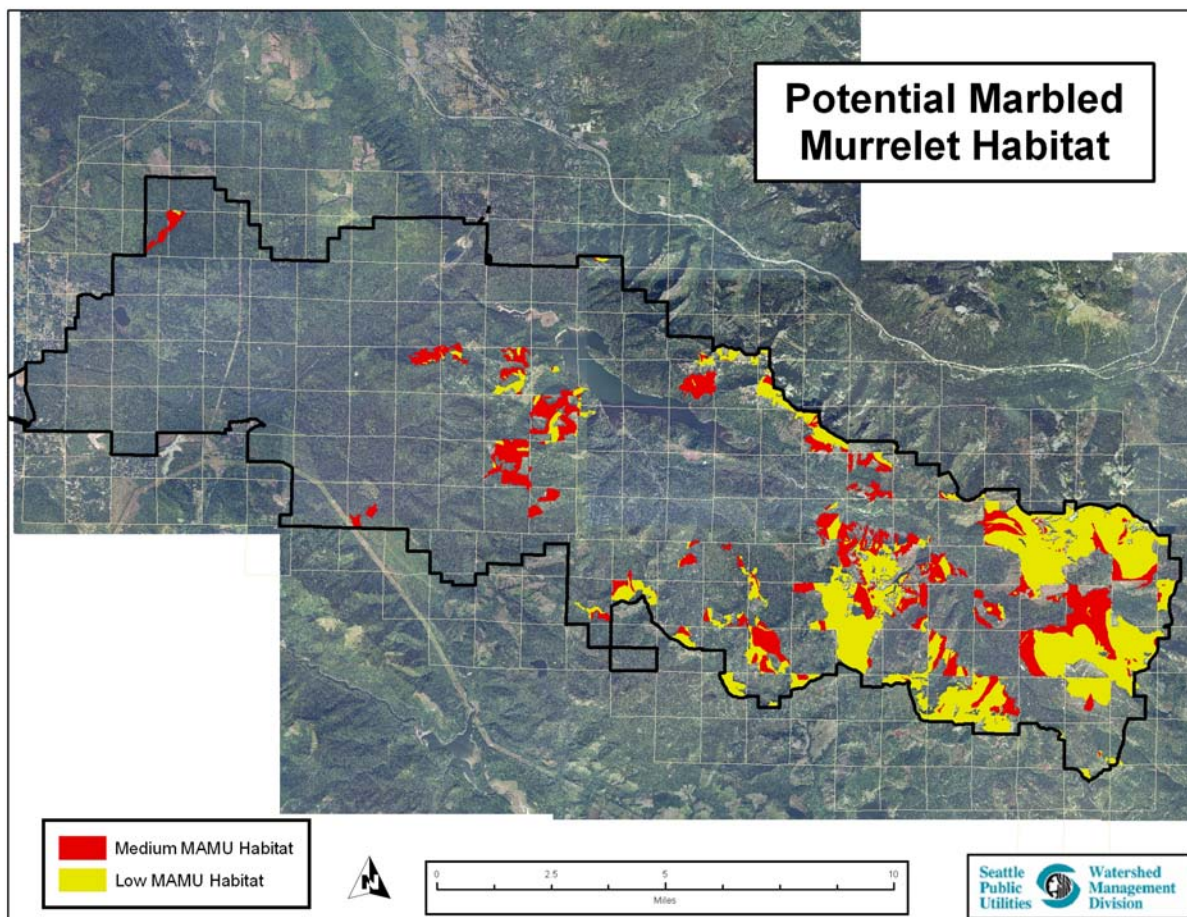
Potential marbled murrelet habitat quality in the Cedar River watershed was primarily stratified by the number of large limbs detected during PSP sampling. An alternative definition was also developed, to augment the branch-size stratification where that data was unknown, based on the number of large trees, the basal area of silver fir (thought not to provide suitable habitat), and the distance to marine waters (Table 6). All of the CRMW is within 52 miles of marine waters.

Table 6. Marbled murrelet habitat.

Habitat	# Large Limbs	Large trees, Silver fir, and Marine distance
High	10+	>10 tpa >30" dbh, <33%BA SF, <37 miles to marine
Medium	6-10	>10 tpa >30" dbh, <33%BA SF
Low	1-5	>10 tpa >30" dbh

Applying this definition of murrelet habitat to the PSP data resulted in each plot being classified as high, medium, or low habitat (Table 2). Unlike classifying owl habitat, polygons were classified as murrelet habitat using the "average PSP habitat" found in each polygon. This approach was taken since only two PSPs were classified as high (see Table 2), and a classification using the "best PSP habitat" would distort the true available habitat. The amount of potential habitat is shown and listed in Figure 2 and Table 7, respectively.

Figure 2. Potential marbled murrelet habitat in the Cedar River Municipal Watershed.



(Source: J:\SSW\WS541\Secure\Fish and Wildlife\MAMU\Maps\MAMU_habitat3.jpg)

Table 7. Potential marbled murrelet habitat in the Cedar River Municipal Watershed.

Habitat Type	Acres
High	0
Medium	5,134
Low	9,012
Total	14,146

Old Forest Classification Report

Discussion

Based on the data from all 37 PSPs, the dichotomy of age in and outside of the Rex basin appears to be largely artificial. The large patch of old forest in the upper Rex is the oldest forest in the watershed and has habitat characteristics more typical of old-growth forest. Other patches of old forest in the Rex have characteristics similar to the old forest found elsewhere in the watershed.

Of the 50 possible polygon classes (5 site classes, 5 aspect classes, and 2 elevation classes), the CRMW has old forest in 32 of them (Table 1). A sampling effort of 37 PSPs is not sufficient to have a statistical representation of each polygon class. It does, however, provide a description of the available habitat in those polygons and provides potential forest restoration targets. Classifying potential habitat for a species based on this method and PSP sample size should therefore be viewed cautiously. The stress should be placed on “potential” and field validated wherever possible. It is hoped that analysis of remote sensing data, in combination with data from PSPs and other forest inventories in all forest types, will someday augment this classification and provide a watershed-wide classification of forest characteristics.

Partially based on the results of this habitat classification, surveys for marbled murrelets in 2005 and 2006 identified two “occupied” old forest stands. Surveys will continue in 2007. Though the effort predates this classification, no northern spotted owls were detected during comprehensive surveys of home-range scale patches of potential habitat the CRMW in 2005.